



wherein:

M is a metal atom:

each  $A^1$  and  $A^2$  is, independently, a monodentate ligand; or  $A^1$  and  $A^2$  are covalently joined together to form a bidentate ligand;

each R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, R<sup>6</sup>, R<sup>7</sup>, R<sup>8</sup>, R<sup>9</sup>, and R<sup>10</sup> is, independently, H, F, Cl, Br, I, R<sup>11</sup>, OR<sup>11</sup>, N(R<sup>11</sup>)<sub>2</sub>, P(R<sup>11</sup>)<sub>2</sub>, P(OR<sup>11</sup>)<sub>2</sub>, POR<sup>11</sup>, PO<sub>2</sub>R<sup>11</sup>, PO<sub>3</sub>R<sup>11</sup>, SR<sup>11</sup>, Si(R<sup>11</sup>)<sub>3</sub>, B(R<sup>11</sup>)<sub>2</sub>, B(OR<sup>11</sup>)<sub>2</sub>, C(O)R<sup>11</sup>, C(O)OR<sup>11</sup>, C(O)N(R<sup>11</sup>)<sub>2</sub>, CN, NO<sub>2</sub>, SO<sub>2</sub>, SOR<sup>11</sup>, SO<sub>2</sub>R<sup>11</sup>, SO<sub>3</sub>R<sup>11</sup>; and additionally, or alternatively, any one or more of R<sup>1</sup> and R<sup>2</sup>, or R<sup>2</sup> and R<sup>3</sup>, or R<sup>3</sup> and R<sup>4</sup>, or R<sup>5</sup> and R<sup>6</sup>, or R<sup>6</sup> and R<sup>7</sup>, or R<sup>7</sup> and R<sup>8</sup>, or R<sup>9</sup> and R<sup>10</sup>, together form, independently, a fused 4- to 7-member cyclic group, wherein said cyclic group is cycloalkyl, cycloheteroalkyl, aryl, or heteroaryl, and wherein said cyclic group is optionally substituted by one or more substituents X;

each R<sup>11</sup> is, independently, H, C<sub>1</sub>-C<sub>20</sub> alkyl, C<sub>2</sub>-C<sub>20</sub> alkenyl, C<sub>2</sub>-C<sub>20</sub> alkynyl, C<sub>1</sub>-C<sub>20</sub> heteroalkyl, C<sub>3</sub>-C<sub>40</sub> aryl, C<sub>3</sub>-C<sub>40</sub> heteroaryl; wherein R<sup>11</sup> is optionally substituted by one or more substituents X;

each X is, independently, H, F, Cl, Br, I, R<sup>12</sup>, OR<sup>12</sup>, N(R<sup>12</sup>)<sub>2</sub>, P(R<sup>12</sup>)<sub>2</sub>, P(OR<sup>12</sup>)<sub>2</sub>, POR<sup>12</sup>, PO<sub>2</sub>R<sup>12</sup>, PO<sub>3</sub>R<sup>12</sup>, SR<sup>12</sup>, Si(R<sup>12</sup>)<sub>3</sub>, B(R<sup>12</sup>)<sub>2</sub>, B(OR<sup>12</sup>)<sub>2</sub>, C(O)R<sup>12</sup>, C(O)OR<sup>12</sup>, C(O)N(R<sup>12</sup>)<sub>2</sub>, CN, NO<sub>2</sub>, SO<sub>2</sub>, SOR<sup>12</sup>, SO<sub>2</sub>R<sup>12</sup>, or SO<sub>3</sub>R<sup>12</sup>;

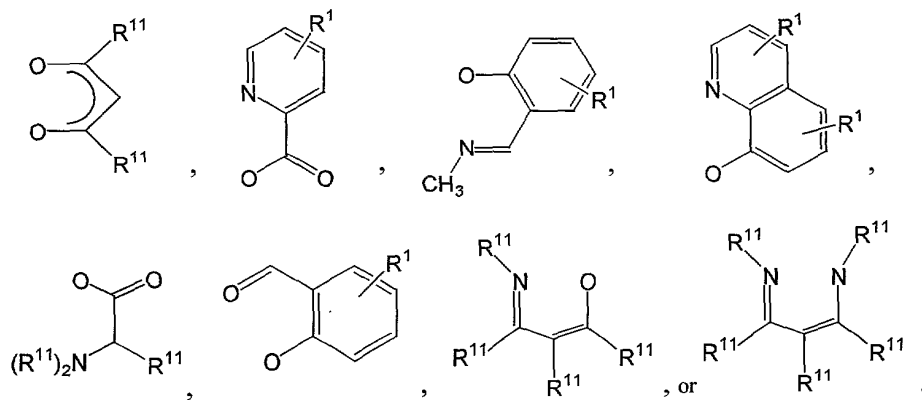
each R<sup>12</sup> is, independently, H, C<sub>1</sub>-C<sub>20</sub> alkyl, C<sub>1</sub>-C<sub>20</sub> perhaloalkyl, C<sub>2</sub>-C<sub>20</sub> alkenyl, C<sub>2</sub>-C<sub>20</sub> alkynyl, C<sub>1</sub>-C<sub>20</sub> heteroalkyl, C<sub>3</sub>-C<sub>40</sub> aryl, or C<sub>3</sub>-C<sub>40</sub> heteroaryl;

$m$  is the formal charge of metal atom M:

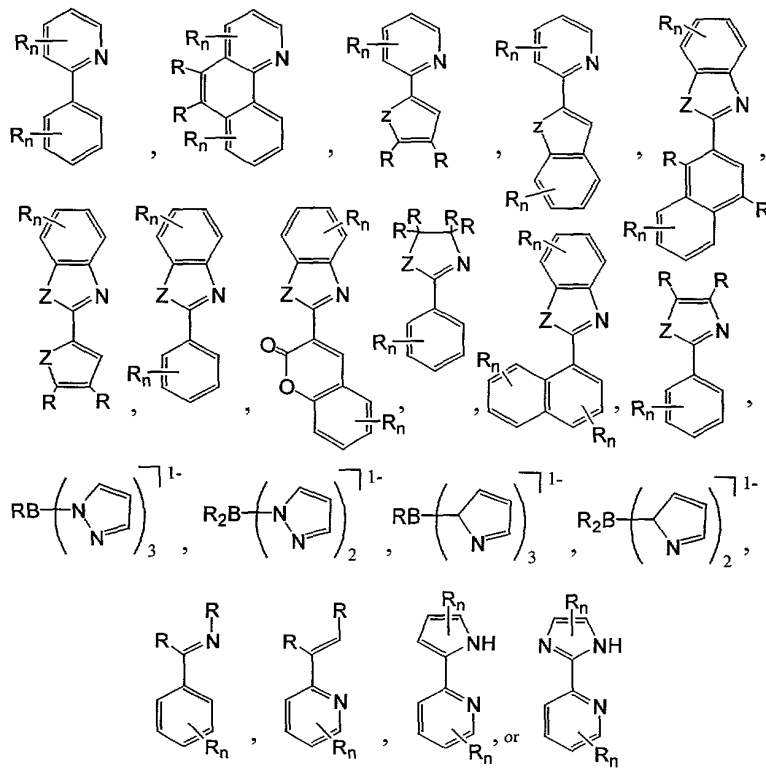
$n$  is 1, 2 or 3; and

wherein at least one of  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , and  $R^{10}$  is not H in compounds of Formula I.

2. A compound of claim 1 having Formula I.
3. A compound of claim 1 having Formula II.
4. A compound of claim 1 having Formula III.
5. A compound of claim 1 wherein M is a heavy metal.
6. A compound of claim 1 wherein M is Ir, Os, Pt, Pb, Re, or Ru.
7. A compound of claim 1 wherein M is Ir.
8. A compound of claim 1 wherein M is Pt.
9. A compound of claim 1 wherein  $A^1$  and  $A^2$  are monodentate ligands.
10. A compound of claim 1 wherein  $A^1$  and  $A^2$  are monodentate ligands having a combined charge of (-1).
11. A compound of claim 1 wherein  $A^1$  or  $A^2$  is F, Cl, Br, I, CO, CN,  $CN(R^{11})$ ,  $SR^{11}$ , SCN, OCN,  $P(R^{11})_3$ ,  $P(OR^{11})_3$ ,  $N(R^{11})_3$ , NO,  $N_3$ , or a nitrogen-containing heterocycle optionally substituted by one or more substituents X.
12. A compound of claim 1 wherein  $A^1$  and  $A^2$  are covalently joined together to form a bidentate ligand.
13. A compound of claim 1 wherein said bidentate ligand is monoanionic.
14. A compound of claim 1 wherein said bidentate ligand is



15. A compound of claim 1 wherein said bidentate ligand coordinates through a carbon atom and a nitrogen atom.
16. A compound of claim 15 wherein said bidentate ligand is a biaryl compound.
17. A compound of claim 1 wherein said bidentate ligand is



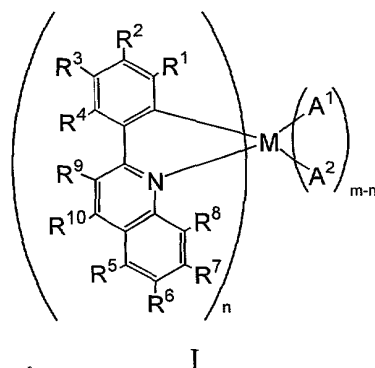
wherein:

Z is O, S, or NR;

each R is, independently,  $R^{11}$ ; and  
n is 0 to 5.

18. A compound of claim 1 wherein said bidentate ligand is acetylacetonate.
19. A compound of claim 1 wherein each  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , and  $R^{10}$  is, independently, H,  $CH_3$ ,  $CF_3$ ,  $OCH_3$ , or F.
20. A compound of claim 1 wherein at least one of  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , and  $R^{10}$  is methyl.
21. A compound of claim 1 wherein at least one of  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , and  $R^{10}$  is trifluoromethyl.
22. A compound of claim 1 wherein at least one of  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , and  $R^{10}$  is methoxy.
23. A compound of claim 1 wherein at least one of  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , and  $R^{10}$  is fluoro.
24. A compound of claim 1 wherein at least one of said  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  is other than H.
25. A compound of claim 1 having a photoluminescence maximum at a wavelength of from about 550 to about 700 nm.
26. A composition comprising a compound of claim 1.
27. The composition of claim 26 further comprising BCP, CBP, OXD7, TAZ, CuPc, NPD, Alq<sub>3</sub>, BAAlq, FIrpq, or Irppy.

28. A compound of Formula I



wherein:

M is a metal atom;

each A<sup>1</sup> and A<sup>2</sup> is, independently, a monodentate ligand; or A<sup>1</sup> and A<sup>2</sup> are covalently joined together to form a bidentate ligand;

each R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, R<sup>6</sup>, R<sup>7</sup>, R<sup>8</sup>, R<sup>9</sup>, and R<sup>10</sup> is, independently, H, an activating group, or a deactivating group; and additionally, or alternatively, any one or more of R<sup>1</sup> and R<sup>2</sup>, or R<sup>2</sup> and R<sup>3</sup>, or R<sup>3</sup> and R<sup>4</sup>, or R<sup>5</sup> and R<sup>6</sup>, or R<sup>6</sup> and R<sup>7</sup>, or R<sup>7</sup> and R<sup>8</sup>, or R<sup>9</sup> and R<sup>10</sup>, together form, independently, a fused 4- to 7-member cyclic group, wherein said cyclic group is cycloalkyl, cycloheteroalkyl, aryl, or heteroaryl, and wherein said cyclic group is optionally substituted by one or more substituents X;

each X is, independently, H, F, Cl, Br, I, R<sup>12</sup>, OR<sup>12</sup>, N(R<sup>12</sup>)<sub>2</sub>, P(R<sup>12</sup>)<sub>2</sub>, P(OR<sup>12</sup>)<sub>2</sub>, POR<sup>12</sup>, PO<sub>2</sub>R<sup>12</sup>, PO<sub>3</sub>R<sup>12</sup>, SR<sup>12</sup>, Si(R<sup>12</sup>)<sub>3</sub>, B(R<sup>12</sup>)<sub>2</sub>, B(OR<sup>12</sup>)<sub>2</sub>, C(O)R<sup>12</sup>, C(O)OR<sup>12</sup>, C(O)N(R<sup>12</sup>)<sub>2</sub>, CN, NO<sub>2</sub>, SO<sub>2</sub>, SOR<sup>12</sup>, SO<sub>2</sub>R<sup>12</sup>, or SO<sub>3</sub>R<sup>12</sup>;

each R<sup>12</sup> is, independently, H, C<sub>1</sub>-C<sub>20</sub> alkyl, C<sub>1</sub>-C<sub>20</sub> perhaloalkyl, C<sub>2</sub>-C<sub>20</sub> alkenyl, C<sub>2</sub>-C<sub>20</sub> alkynyl, C<sub>1</sub>-C<sub>20</sub> heteroalkyl, C<sub>3</sub>-C<sub>40</sub> aryl, or C<sub>3</sub>-C<sub>40</sub> heteroaryl;

m is the formal charge of metal atom M;

n is 1, 2 or 3; and

wherein at least one of R<sup>3</sup>, R<sup>9</sup>, and R<sup>10</sup> is an activating group, or wherein at least one of R<sup>3</sup>, R<sup>4</sup>, R<sup>9</sup>, and R<sup>10</sup> is a deactivating group.

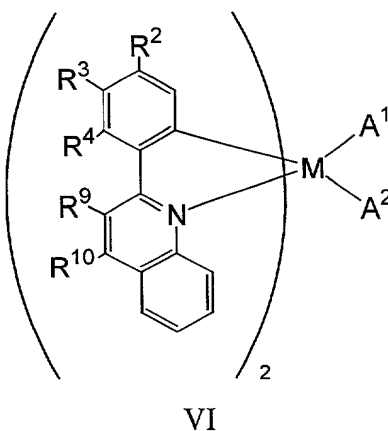
29. The compound of claim 28 wherein at least one of R<sup>3</sup>, R<sup>9</sup>, and R<sup>10</sup> is an activating group.

30. The compound of claim 29 wherein said activating group is alkyl, heteroalkyl, aryl, heteroaryl, alkoxy, aryloxy, hydroxy, mercapto, thiolato, amino, phosphino, alkylcarbonylamino, or arylcarbonylamino.
31. The compound of claim 29 wherein said activating group is methyl or methoxy.
32. The compound of claim 28 wherein at least one of  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  is a deactivating group.
33. The compound of claim 32 wherein said deactivating group is halo, cyano, nitro, aldehyde, alkylcarbonyl, arylcarbonyl, ammonium, perhaloalkyl, carboxylic acid, alkoxycarbonyl, aryloxycarbonyl, or sulfo.
34. The compound of claim 32 wherein said deactivating group is F or  $CF_3$ .
35. The compound of claim 28 wherein at least two of said  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , and  $R^{10}$  are activating or deactivating groups.
36. The compound of claim 28 wherein  $A^1$  and  $A^2$  are covalently joined together to form a bidentate ligand.
37. The compound of claim 28 wherein said bidentate ligand is monoanionic.
38. The compound of claim 28 wherein said bidentate ligand is acetylacetonate (acac), picolinate (pic), hexafluoroacetylacetonate, salicylidene, or 8-hydroxyquinolate.
39. The compound of claim 28 wherein said bidentate ligand is acetylacetonate.
40. A compound of claim 28 wherein M is a heavy metal.
41. A compound of claim 28 wherein M is Ir, Os, Pt, Pb, Re, or Ru.

42. A compound of claim 28 wherein M is Ir.

43. A compound of claim 28 wherein M is Pt.

44. A compound of Formula VI



wherein:

M is a metal atom;

each A<sup>1</sup> and A<sup>2</sup> is; independently, a monodentate ligand; or A<sup>1</sup> and A<sup>2</sup> are covalently joined together to form a bidentate ligand; and

R<sup>4</sup> is F; and R<sup>2</sup>, R<sup>3</sup>, R<sup>9</sup>, and R<sup>10</sup> are each, independently, H, an activating group or deactivating group; or

R<sup>4</sup> is OCH<sub>3</sub>; and R<sup>2</sup>, R<sup>3</sup>, R<sup>9</sup>, and R<sup>10</sup> are each, independently, H, an activating group or deactivating group; or

R<sup>3</sup> is OCH<sub>3</sub>; and R<sup>2</sup>, R<sup>4</sup>, R<sup>9</sup>, and R<sup>10</sup> are each, independently, H, an activating group or deactivating group; or

R<sup>2</sup> is OCH<sub>3</sub>; and R<sup>3</sup>, R<sup>4</sup>, R<sup>9</sup>, and R<sup>10</sup> are each, independently, H, an activating group or deactivating group; or

R<sup>4</sup> is CF<sub>3</sub>; and R<sup>2</sup>, R<sup>3</sup>, R<sup>9</sup>, and R<sup>10</sup> are each, independently, H, an activating group or deactivating group; or

R<sup>3</sup> is CF<sub>3</sub>; and R<sup>2</sup>, R<sup>4</sup>, R<sup>9</sup>, and R<sup>10</sup> are each, independently, H, an activating group or deactivating group; or

R<sup>2</sup> is CF<sub>3</sub>; and R<sup>3</sup>, R<sup>4</sup>, R<sup>9</sup>, and R<sup>10</sup> are each, independently, H, an activating group or deactivating group; or

$R^2$  and  $R^4$  are each F; and  $R^3$ ,  $R^9$ , and  $R^{10}$  are each, independently, H, an activating group or deactivating group; or

$R^9$  is  $\text{CH}_3$ ; and  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^{10}$  are each, independently, H, an activating group or deactivating group; or

$R^{10}$  is  $\text{CH}_3$ ; and  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^9$  are each, independently, H, an activating group or deactivating group.

45. The compound of claim 44 wherein  $A^1$  and  $A^2$  are covalently joined together to form a bidentate ligand.

46. The compound of claim 44 wherein said bidentate ligand is monoanionic.

47. The compound of claim 44 wherein said bidentate ligand is acetylacetonate (acac), picolinate (pic), hexafluoroacetylacetonate, salicylidene, or 8-hydroxyquinolate.

48. The compound of claim 44 wherein said bidentate ligand is acetylacetonate.

49. A compound of claim 44 wherein M is a heavy metal.

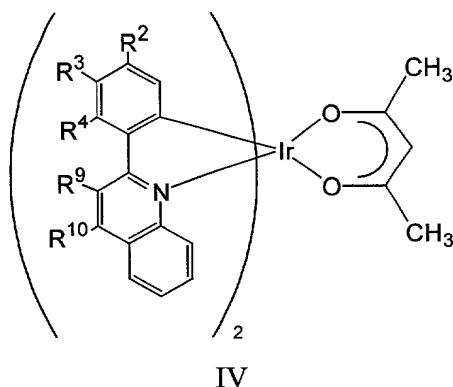
50. A compound of claim 44 wherein M is Ir, Os, Pt, Pb, Re, or Ru.

51. A compound of claim 44 wherein M is Ir.

52. A compound of claim 44 wherein M is Pt.

53. A compound of Formula IV



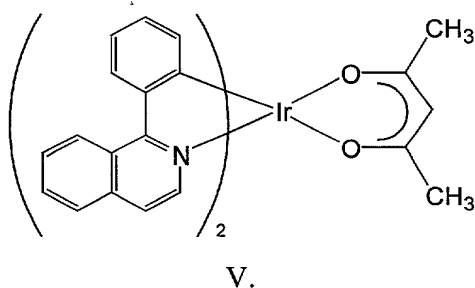


wherein:

$R^4$  is F; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^4$  is  $OCH_3$ ; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^3$  is  $OCH_3$ ; and  $R^2$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^2$  is  $OCH_3$ ; and  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^4$  is  $CF_3$ ; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^3$  is  $CF_3$ ; and  $R^2$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^2$  is  $CF_3$ ; and  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^2$  and  $R^4$  are each F; and  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^4$  and  $R^{10}$  are each  $CH_3$ ; and  $R^2$ ,  $R^3$ , and  $R^9$  are each H; or  
 $R^9$  is  $CH_3$ ; and  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^{10}$  are each H; or  
 $R^{10}$  is  $CH_3$ ; and  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^9$  are each H.

54. The compound of claim 53 wherein  $R^4$  is F; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H.
55. The compound of claim 53 wherein  $R^4$  is  $OCH_3$ ; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H.
56. The compound of claim 53 wherein  $R^3$  is  $OCH_3$ ; and  $R^2$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H.
57. The compound of claim 53 wherein  $R^2$  is  $OCH_3$ ; and  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H.

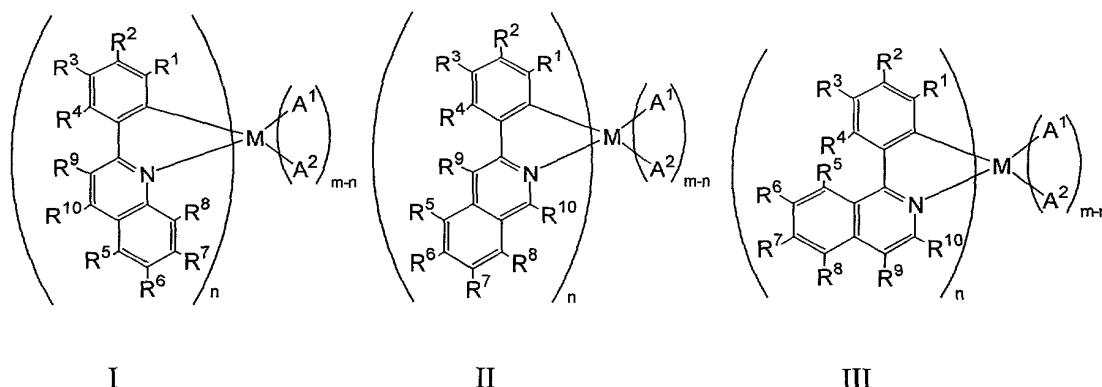
58. The compound of claim 53 wherein  $R^4$  is  $CF_3$ ; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H.
59. The compound of claim 53 wherein  $R^3$  is  $CF_3$ ; and  $R^2$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H.
60. The compound of claim 53 wherein  $R^2$  is  $CF_3$ ; and  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H.
61. The compound of claim 53 wherein  $R^2$  and  $R^4$  are each F; and  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H.
62. The compound of claim 53 wherein  $R^4$  and  $R^{10}$  are each  $CH_3$ ; and  $R^2$ ,  $R^3$ , and  $R^9$  are each H.
63. The compound of claim 53 wherein  $R^9$  is  $CH_3$ ; and  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^{10}$  are each H.
64. The compound of claim 53 wherein  $R^{10}$  is  $CH_3$ ; and  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^9$  are each H.
65. A compound of Formula V



66. A method of increasing the wavelength of a photoluminescence maximum for a compound of claim 1, said method comprising choosing substituents  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , or  $R^{10}$  such that at least one of said substituents is an activating group that influences the HOMO energy level of said compound, or at least one of said substituents is a deactivating group that influences the LUMO energy level of said compound.

67. A method of decreasing the wavelength of a photoluminescence maximum for a compound of claim 1, said method comprising choosing substituents  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , or  $R^{10}$  such that at least one of said substituents is a deactivating group that influences the HOMO energy level of said compound, or at least one of said substituents is an activating group that influences the LUMO energy level of said compound.

68. An organic light emitting device comprising a compound of Formula I, II, or III



wherein:

M is a metal atom;

each  $A^1$  and  $A^2$  is, independently, a monodentate ligand; or  $A^1$  and  $A^2$  are covalently joined together to form a bidentate ligand;

each  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , and  $R^{10}$  is, independently, H, F, Cl, Br, I,  $R^{11}$ ,  $OR^{11}$ ,  $N(R^{11})_2$ ,  $P(R^{11})_2$ ,  $P(OR^{11})_2$ ,  $POR^{11}$ ,  $PO_2R^{11}$ ,  $PO_3R^{11}$ ,  $SR^{11}$ ,  $Si(R^{11})_3$ ,  $B(R^{11})_2$ ,  $B(OR^{11})_2$ ,  $C(O)R^{11}$ ,  $C(O)OR^{11}$ ,  $C(O)N(R^{11})_2$ , CN,  $NO_2$ ,  $SO_2$ ,  $SOR^{11}$ ,  $SO_2R^{11}$ ,  $SO_3R^{11}$ ; and additionally, or alternatively, any one or more of  $R^1$  and  $R^2$ , or  $R^2$  and  $R^3$ , or  $R^3$  and  $R^4$ , or  $R^5$  and  $R^6$ , or  $R^6$  and  $R^7$ , or  $R^7$  and  $R^8$ , or  $R^9$  and  $R^{10}$ , together form, independently, a fused 4- to 7-member cyclic group, wherein said cyclic group is cycloalkyl, cycloheteroalkyl, aryl, or heteroaryl, and wherein said cyclic group is optionally substituted by one or more substituents X;

each  $R^{11}$  is, independently, H,  $C_1$ - $C_{20}$  alkyl,  $C_2$ - $C_{20}$  alkenyl,  $C_2$ - $C_{20}$  alkynyl,  $C_1$ - $C_{20}$  heteroalkyl,  $C_3$ - $C_{40}$  aryl,  $C_3$ - $C_{40}$  heteroaryl; wherein  $R^{11}$  is optionally substituted by one or more substituents X;

each X is, independently, H, F, Cl, Br, I,  $R^{12}$ ,  $OR^{12}$ ,  $N(R^{12})_2$ ,  $P(R^{12})_2$ ,  $P(OR^{12})_2$ ,  $POR^{12}$ ,  $PO_2R^{12}$ ,  $PO_3R^{12}$ ,  $SR^{12}$ ,  $Si(R^{12})_3$ ,  $B(R^{12})_2$ ,  $B(OR^{12})_2$ ,  $C(O)R^{12}$ ,  $C(O)OR^{12}$ ,  $C(O)N(R^{12})_2$ , CN,  $NO_2$ ,  $SO_2$ ,  $SOR^{12}$ ,  $SO_2R^{12}$ , or  $SO_3R^{12}$ ;

each  $R^{12}$  is, independently, H,  $C_1$ - $C_{20}$  alkyl,  $C_1$ - $C_{20}$  perhaloalkyl,  $C_2$ - $C_{20}$  alkenyl,  $C_2$ - $C_{20}$  alkynyl,  $C_1$ - $C_{20}$  heteroalkyl,  $C_3$ - $C_{40}$  aryl, or  $C_3$ - $C_{40}$  heteroaryl;

m is the formal charge of metal atom M;

n is 1, 2 or 3; and

wherein at least one of  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , and  $R^{10}$  is not H in compounds of Formula I.

69. The device of claim 68 wherein said compound has Formula I.
70. The device of claim 68 wherein said compound has Formula II.
71. The device of claim 68 wherein said compound has Formula III.
72. The device of claim 68 wherein said device includes an emissive layer comprising said compound.
73. The device of claim 72 wherein said emissive layer consists essentially of said compound.
74. The device of claim 72 wherein said emissive layer comprises host material doped with said compound.
75. The device of claim 74 wherein said compound comprises from about 1 to about 20 wt% of said emissive layer.
76. The device of claim 74 wherein said host material comprises BCP, CBP, OXD7, TAZ, CuPc, NPD, Alq<sub>3</sub>, or BAlq.

77. The device of claim 74 wherein said emissive layer further comprises Flrpic or Irppy.

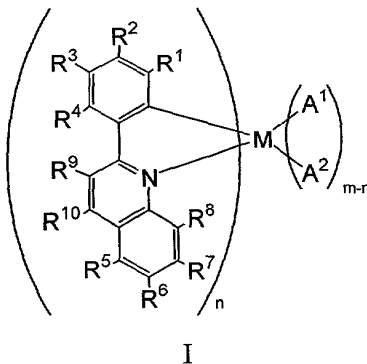
78. The device of claim 68 having an electroluminescence maximum of from about 550 to about 700 nm.

79. The device of claim 68 having color index coordinates (CIE) of from about 0.5 to about 0.8 for x and about 0.2 to about 0.5 for y.

80. The device of claim 68 having an external quantum efficiency greater than about 4% at a brightness greater than about 10 cd/m<sup>2</sup>.

81. The device of claim 68 having an external quantum efficiency greater than about 4% at a brightness greater than about 100 cd/m<sup>2</sup>.

82. An organic light emitting device comprising a compound of Formula I



wherein:

M is a metal atom;

each A<sup>1</sup> and A<sup>2</sup> is, independently, a monodentate ligand; or A<sup>1</sup> and A<sup>2</sup> are covalently joined together to form a bidentate ligand;

each R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, R<sup>6</sup>, R<sup>7</sup>, R<sup>8</sup>, R<sup>9</sup>, and R<sup>10</sup> is, independently, H, an activating group, or a deactivating group; and additionally, or alternatively, any one or more of R<sup>1</sup> and R<sup>2</sup>, or R<sup>2</sup> and R<sup>3</sup>, or R<sup>3</sup> and R<sup>4</sup>, or R<sup>5</sup> and R<sup>6</sup>, or R<sup>6</sup> and R<sup>7</sup>, or R<sup>7</sup> and R<sup>8</sup>, or R<sup>9</sup> and R<sup>10</sup>, together form, independently, a fused 4- to 7-member cyclic group, wherein said

cyclic group is cycloalkyl, cycloheteroalkyl, aryl, or heteroaryl, and wherein said cyclic group is optionally substituted by one or more substituents X;

each X is, independently, H, F, Cl, Br, I,  $R^{12}$ ,  $OR^{12}$ ,  $N(R^{12})_2$ ,  $P(R^{12})_2$ ,  $P(OR^{12})_2$ ,  $POR^{12}$ ,  $PO_2R^{12}$ ,  $PO_3R^{12}$ ,  $SR^{12}$ ,  $Si(R^{12})_3$ ,  $B(R^{12})_2$ ,  $B(OR^{12})_2$ ,  $C(O)R^{12}$ ,  $C(O)OR^{12}$ ,  $C(O)N(R^{12})_2$ , CN,  $NO_2$ ,  $SO_2$ ,  $SOR^{12}$ ,  $SO_2R^{12}$ , or  $SO_3R^{12}$ ;

each  $R^{12}$  is, independently, H,  $C_1$ - $C_{20}$  alkyl,  $C_1$ - $C_{20}$  perhaloalkyl,  $C_2$ - $C_{20}$  alkenyl,  $C_2$ - $C_{20}$  alkynyl,  $C_1$ - $C_{20}$  heteroalkyl,  $C_3$ - $C_{40}$  aryl, or  $C_3$ - $C_{40}$  heteroaryl;

m is the formal charge of metal atom M;

n is 1, 2 or 3; and

wherein at least one of  $R^3$ ,  $R^9$ , and  $R^{10}$  is an activating group, or wherein at least one of  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  is a deactivating group.

83. The device of claim 82 wherein at least one of  $R^3$ ,  $R^9$ , and  $R^{10}$  is an activating group.

84. The device of claim 83 wherein said activating group is alkyl, heteroalkyl, aryl, heteroaryl, alkoxy, aryloxy, hydroxy, mercapto, thiolato, amino, phosphino, alkylcarbonylamino, or arylcarbonylamino.

85. The device of claim 83 wherein said activating group is methyl or methoxy.

86. The device of claim 82 wherein at least one of  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  is a deactivating group.

87. The device of claim 86 wherein said deactivating group is halo, cyano, nitro, aldehyde, alkylcarbonyl, arylcarbonyl, ammonium, perhaloalkyl, carboxylic acid, alkoxycarbonyl, aryloxycarbonyl, or sulfo.

88. The device of claim 86 wherein said deactivating group is F or  $CF_3$ .

89. The device of claim 82 wherein at least two of said  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , and  $R^{10}$  are activating or deactivating groups.

90. The device of claim 82 wherein A<sup>1</sup> and A<sup>2</sup> are covalently joined together to form a bidentate ligand.
91. The device of claim 82 wherein said bidentate ligand is monoanionic.
92. The device of claim 82 wherein said bidentate ligand is acetylacetonate (acac), picolinate (pic), hexafluoroacetylacetonate, salicylidene, or 8-hydroxyquinolate.
93. The device of claim 82 wherein said bidentate ligand is acetylacetonate.
94. A device of claim 82 wherein M is a heavy metal.
95. A device of claim 82 wherein M is Ir, Os, Pt, Pb, Re, or Ru.
96. A device of claim 82 wherein M is Ir.
97. A device of claim 82 wherein M is Pt.
98. The device of claim 82 wherein said device includes an emissive layer comprising said compound.
99. The device of claim 98 wherein said emissive layer consists essentially of said compound.
100. The device of claim 98 wherein said emissive layer comprises host material doped with said compound.
101. The device of claim 100 wherein said compound comprises from about 1 to about 20 wt% of said emissive layer.

102. The device of claim 100 wherein said host material comprises BCP, CBP, OXD7, TAZ, CuPc, NPD, Alq<sub>3</sub>, or BAlq.

103. The device of claim 100 wherein said emissive layer further comprises FIrpic or Irppy.

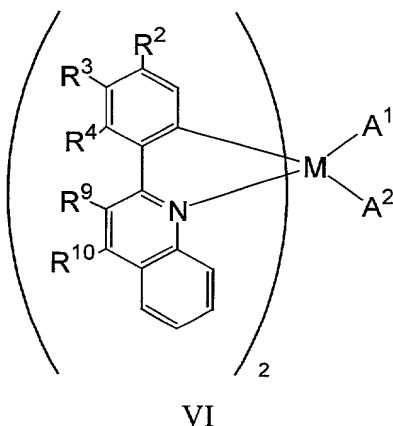
104. The device of claim 82 having an electroluminescence maximum of from about 550 to about 700 nm.

105. The device of claim 82 having color index coordinates (CIE) of from about 0.5 to about 0.8 for *x* and about 0.2 to about 0.5 for *y*.

106. The device of claim 82 having an external quantum efficiency greater than about 4% at a brightness greater than about 10 cd/m<sup>2</sup>.

107. The device of claim 82 having an external quantum efficiency greater than about 4% at a brightness greater than about 100 cd/m<sup>2</sup>.

108. An organic light emitting device comprising a compound of Formula VI



wherein:

M is a metal atom;

each A<sup>1</sup> and A<sup>2</sup> is, independently, a monodentate ligand; or A<sup>1</sup> and A<sup>2</sup> are covalently joined together to form a bidentate ligand; and



$R^4$  is F; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each, independently, H, an activating group or deactivating group; or

$R^4$  is  $\text{OCH}_3$ ; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each, independently, H, an activating group or deactivating group; or

$R^3$  is  $\text{OCH}_3$ ; and  $R^2$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each, independently, H, an activating group or deactivating group; or

$R^2$  is  $\text{OCH}_3$ ; and  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each, independently, H, an activating group or deactivating group; or

$R^4$  is  $\text{CF}_3$ ; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each, independently, H, an activating group or deactivating group; or

$R^3$  is  $\text{CF}_3$ ; and  $R^2$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each, independently, H, an activating group or deactivating group; or

$R^2$  is  $\text{CF}_3$ ; and  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each, independently, H, an activating group or deactivating group; or

$R^2$  and  $R^4$  are each F; and  $R^3$ ,  $R^9$ , and  $R^{10}$  are each, independently, H, an activating group or deactivating group; or

$R^9$  is  $\text{CH}_3$ ; and  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^{10}$  are each, independently, H, an activating group or deactivating group; or

$R^{10}$  is  $\text{CH}_3$ ; and  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^9$  are each, independently, H, an activating group or deactivating group.

109. The device of claim 108 wherein  $A^1$  and  $A^2$  are covalently joined together to form a bidentate ligand.

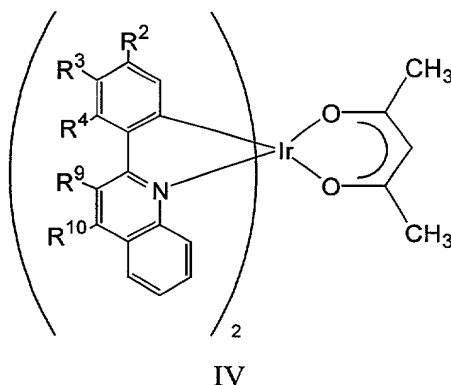
110. The device of claim 108 wherein said bidentate ligand is monoanionic.

111. The device of claim 108 wherein said bidentate ligand is acetylacetonate (acac), picolinate (pic), hexafluoroacetylacetonate, salicylidene, or 8-hydroxyquinolate.

112. The device of claim 108 wherein said bidentate ligand is acetylacetonate.

113. A device of claim 108 wherein M is a heavy metal.

114. A device of claim 108 wherein M is Ir, Os, Pt, Pb, Re, or Ru.
115. A device of claim 108 wherein M is Ir.
116. A device of claim 108 wherein M is Pt.
117. An organic light emitting device comprising a compound of Formula IV

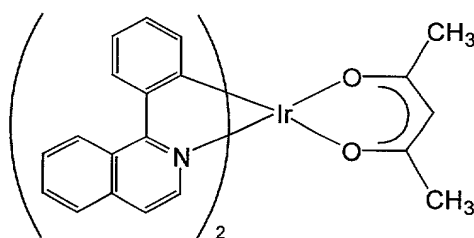


wherein:

$R^4$  is F; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^4$  is  $\text{OCH}_3$ ; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^3$  is  $\text{OCH}_3$ ; and  $R^2$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^2$  is  $\text{OCH}_3$ ; and  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^4$  is  $\text{CF}_3$ ; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^3$  is  $\text{CF}_3$ ; and  $R^2$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^2$  is  $\text{CF}_3$ ; and  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^2$  and  $R^4$  are each F; and  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H; or  
 $R^4$  and  $R^{10}$  are each  $\text{CH}_3$ ; and  $R^2$ ,  $R^3$ , and  $R^9$  are each H; or  
 $R^9$  is  $\text{CH}_3$ ; and  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^{10}$  are each H; or  
 $R^{10}$  is  $\text{CH}_3$ ; and  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^9$  are each H.

118. The device of claim 117 wherein  $R^4$  is F; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H.
119. The device of claim 117 wherein  $R^4$  is  $\text{OCH}_3$ ; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H.

120. The device of claim 117 wherein  $R^3$  is  $OCH_3$ ; and  $R^2$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H.
121. The device of claim 117 wherein  $R^2$  is  $OCH_3$ ; and  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H.
122. The device of claim 117 wherein  $R^4$  is  $CF_3$ ; and  $R^2$ ,  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H.
123. The device of claim 117 wherein  $R^3$  is  $CF_3$ ; and  $R^2$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H.
124. The device of claim 117 wherein  $R^2$  is  $CF_3$ ; and  $R^3$ ,  $R^4$ ,  $R^9$ , and  $R^{10}$  are each H.
125. The device of claim 117 wherein  $R^2$  and  $R^4$  are each F; and  $R^3$ ,  $R^9$ , and  $R^{10}$  are each H.
126. The device of claim 117 wherein  $R^4$  and  $R^{10}$  are each  $CH_3$ ; and  $R^2$ ,  $R^3$ , and  $R^9$  are each H.
127. The device of claim 117 wherein  $R^9$  is  $CH_3$ ; and  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^{10}$  are each H.
128. The device of claim 119 wherein  $R^{10}$  is  $CH_3$ ; and  $R^2$ ,  $R^3$ ,  $R^4$ , and  $R^9$  are each H.
129. An organic light emitting device comprising a compound of Formula V



V.

130. A method of increasing the wavelength of an electroluminescence maximum of an organic light emitting device comprising a compound of claim 1, said method comprising choosing substituents  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , or  $R^{10}$  such that at

least one of said substituents is an activating group that influences the HOMO energy level of said compound, or at least one of said substituents is a deactivating group that influences the LUMO energy level of said compound.

131. A method of decreasing the wavelength of an electroluminescence maximum of an organic light emitting device comprising a compound of claim 1, said method comprising choosing substituents  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ , or  $R^{10}$  such that at least one of said substituents is a deactivating group that influences the HOMO energy level of said compound, or at least one of said substituents is an activating group that influences the LUMO energy level of said compound.

132. A pixel comprising the device of claim 68.

133. A pixel comprising the device of claim 82.

134. A pixel comprising the device of claim 108.

135. A pixel comprising the device of claim 117.

136. A pixel comprising the device of claim 129.

137. An electronic display comprising the device of claim 68.

138. An electronic display comprising the device of claim 82.

139. An electronic display comprising the device of claim 108.

140. An electronic display comprising the device of claim 117.

141. An electronic display comprising the device of claim 129.

organics were washed with a saturated solution of sodium chloride and separated. The organic layer was dried over magnesium sulfate, concentrated, and purified on a silica gel column using 20% ethyl acetate and hexanes as the eluants. The pure fractions were combined and concentrated to give 2-phenyl-4-methylquinoline (4.0 g, 61% yield) as an oil.

#### Step 2

2-Phenyl-4-methylquinoline (4.0 g, 18 mmol) and iridium(III) chloride trihydrate (3.2 g, 9 mmol) were dissolved into a solution containing 80 mL of 2-methoxyethanol and 20 mL of water. The reaction mixture was refluxed for 18 hours and cooled to room temperature. The red/brown precipitate was collected by vacuum filtration and washed once with absolute ethanol followed by hexanes to give the dichloro-bridged dimer (3.0 g, 25 % yield).

#### Step 3

The dichloro-bridged dimer (3.0 g, 2.3 mmol) and 2,4-pentanedione (2.3 g, 23 mmol) were dissolved into a solution containing 100 mL of 2-methoxyethanol and sodium carbonate (4.8 g in 50 mL). The reaction mixture was heated to reflux and stirred under a nitrogen atmosphere for 17 hours. The reaction mixture was cooled and the red precipitate was collected by vacuum filtration to give bis[2-(2,4-difluorophenyl)quinoline]iridium(III) acetylacetonate (2.1 g) as a red solid. The material was further purified by vacuum sublimation.

### Example 14: Synthesis of Bis(2-phenyl-3-methylquinoline)iridium(III) acetylacetonate (Compound 12)

#### Step 1

2-Chloro-3-methylquinoline (5.43 g, 30.6 mmol), phenylboronic acid (4.47 g, 36.7 mmol), Pd(II) acetate (0.17g, 0.76 mmol), and triphenylphosphine (0.80 g, 3.06 mmol) were dissolved in 100 mL DME. To the stirred solution was added K<sub>2</sub>CO<sub>3</sub> (11.4g dissolved into 41 mL H<sub>2</sub>O). The entire mixture was allowed to stir at reflux for 18 hours under N<sub>2</sub> atmosphere. The cooled mixture was then removed of water, enriched with 150 mL of ethyl acetate, extracted three times from brine, dried over anhydrous sodium

sulfate, filtered and evaporated of solvent. The crude liquid was then purified on a silica gel column using 20% ethyl acetate/hexanes. The purest fractions were combined to give 2-phenyl-3-methylquinoline (6.42 g, 95.8% yield).

5 *Step 2*

3-Methyl-2-phenylquinoline (5.80 g, 26 mmol) was stirred in 100 mL 2-methoxyethanol/25mL H<sub>2</sub>O and to the stirred solution was added iridium (III) chloride hydrate (4.9 g, 13 mmol). The reaction mixture was allowed to stir under N<sub>2</sub> atmosphere at 100 °C for 24 hours. The solids were collected on a filter, and rinsed with ethanol to  
10 give the dichloro-bridged dimer (2.72 g, 30.9% yield).

*Step 3*

3-Methyl-2-phenylquinoline Ir dimer (2.72 g) was stirred in 80 mL 2-methoxyethanol and to the solution was added sodium carbonate (2.72 g) and 2,4-pentanedione (1.02 g). This was allowed to stir for 24 hours under N<sub>2</sub> atmosphere. The  
15 reaction mixture was filtered and the solids washed with water. The solids were then filtered again and rinsed with hexanes. The amount collected gave bis(2-phenyl-3-methylquinoline)iridium(III) acetylacetonate (0.85 g, 29.8% yield). This material was purified by vacuum sublimation.

20 **Example 15: Synthesis of Bis(phenylisoquinoline)iridium(III) acetylacetonate (Compound 13)**

*Step 1*

1-Chloroisoquinoline (5.0 g, 30 mmol) and phenylboronic acid (4.5 g, 37 mmol)  
25 was dissolved into 100 mL of ethylene glycol dimethyl ether, followed by the addition of triphenylphosphine (0.7 g, 3 mmol) and Pd(II) acetate (0.17 g, 0.75 mmol). The reaction mixture was refluxed for 16 hours. The reaction mixture was cooled and the aqueous layer discarded. Additional ethyl acetate was added and the solvent was washed with a saturated solution of sodium chloride, dried over magnesium sulfate and concentrated to  
30 give 1-phenylisoquinoline (5.0 g, 79% yield)

*Step 2*

1-Phenylisoquinoline (5.0 g, 24 mmol) and iridium(III) chloride trihydrate (4.5 g, 12 mmol) was add to a solution containing 80 mL of 2-methoxyethanol and 20 mL of water. The reaction was heated to reflux and stirred under a nitrogen atmosphere for 12 hours. The reaction mixture was cooled and the red/brown precipitate was collected by vacuum filtration and washed once with hexanes. The dichloro-bridged dimer (5.3 g, 30% yield) was dried and used directly in the next step.

### Step 3

The dichloro-bridged dimer (2.0 g, 1.6 mmol) and 2,4-pentanedione (1.6 g, 16 mmol) were added to 100 mL of 2-methoxyethanol to which a solution of sodium carbonate (3.34 g, 50 mL) was added and the reaction mixture heated to reflux. The reaction mixture was cooled after 16 hours and the crude product collected by vacuum filtration to give bis(phenylisoquinoline)iridium(III) acetylacetonate (1.0 g). The crude material was purified by vacuum sublimation.

As those skilled in the art will appreciate, numerous changes and modifications can be made to the preferred embodiments of the invention without departing from the spirit of the invention. It is intended that all such variations fall within the scope of the invention. Throughout this specification, various groupings are employed to conveniently describe constituent variables of compounds and groups of various related moieties. It is specifically intended that each occurrence of such groups throughout this specification include every possible subcombination of the members of the groups, including the individual members thereof.

It is intended that each of the patents, applications, and printed publications mentioned in this patent document be hereby incorporated by reference in its entirety.